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A NEW RHINOCEROS FROM THE SIWALIK BEDS OF INDIA

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INTRODUCTION

The collection of fossil mammals obtained by Dr. Barnum Brown from the Siwalik series of northern India, for The American Museum of Natural History, contains a representative group of rhinocerotid remains, among which are some specimens from the Lower Siwaliks, that would seem to be indicative of a new genus and species of the Rhinocerotidae. These specimens consist of a very fine skull and some teeth, which will be described in the following pages. The illustrations for this paper are made from photographs taken by Hugh Rice and retouched by Louise Waller Germann.

DESCRIPTION

GAINDATHERIUM,[1] new genus

An Upper Tertiary rhinoceros of medium size, with a "saddle shaped" skull having a single horn on the nasals, and with brachyodont, simple molar teeth. The orbit is located in an approximately central position above the first molar; the occiput is vertical; the postglenoid and post-tympanic are fused, forming a closed tube for the external auditory meatus. There are two upper incisors, of which the lateral one is quite small; the upper molars are without an antecrochet or a crista, and the crochet is but slightly developed.

GENERIC TYPE.—**Gaindatherium browni,** new species.

Gaindatherium browni,[2] new genus and species

TYPE.—Amer. Mus. No. 19409, an almost complete skull. From the Lower Siwaliks, Chinji zone, near Chinji Rest House, Salt Range, Attock District, Punjab.

PARATYPES.—

Amer. Mus. No. 29838, associated right and left upper and lower dentitions. From the Lower Siwaliks, Chinji zone, near Chinji Rest House, Salt Range, Attock District, Junjab.

Amer. Mus. No. 19471, a mandibular symphysis, with right I_2, and right P_3-M_1, badly crushed. From the lower portion of the Middle Siwaliks, Nagri zone, 1000 feet below the bone beds at Bhandar. One mile south of Nathot, Salt Range, Jhelum

[1] From *Gaindā*, a Hindustani word for the rhinoceros, and θηριον, meaning beast.
[2] Named in honor of Barnum Brown, who made the Siwalik collection for the American Museum.

District, Punjab. This specimen is provisionally referred to the species under consideration.

Amer. Mus. No. 29793, an upper incisor tooth. From the Lower Siwaliks, Chinji zone, about 500 feet above the level of Chinji Rest House. One and one-half miles west of Chinji Rest House, Salt Range, Attock District, Punjab.

HORIZON AND LOCALITY.—From the Lower Siwaliks, Chinji zone. The species may, however, extend up into the lower portion of the Middle Siwaliks, that is, into the Nagri zone. It is, however, typically of Chinji age. The locality is near Chinji Rest House, south of Chinji village, Salt Range, Attock District, Punjab.

DIAGNOSIS.—The specific diagnosis is the same as the generic diagnosis, presented above.

THE SKULL

The rather striking resemblance of the skull of this new form, as exemplified by Amer. Mus. No. 19409, to the skull of *Dicerorhinus sumatrensis*, a similarity due to the relatively primitive character of both species rather than to a linear phylogenetic relationship, is at once apparent when the two species are compared. A careful study of the specimen under consideration will show, however, that it presents many basic resemblances to *Rhinoceros unicornis*, and the comparisons of the fossil to the modern Indian rhinoceros, as well as to the Sumatran form, will be brought out in the succeeding paragraphs.

As seen from the side, the cranial profile of this new Siwalik skull is saddle-shaped, a fact pointed out in the diagnosis, with the nasals and the occipital region rising considerably above the supraorbital portion of the frontals. This at once suggests the possible affinities of the fossil with the modern genus *Rhinoceros*. The nasals are quite convex and transversely broad, and their upper surface is pitted for the attachment of a strong "horn." There are no evidences whatsoever of the presence of a frontal horn.

The anterior border of the orbit is located almost exactly midway between the front and the back of the skull, and directly above the middle of the first molar. Here we see the expression of a primitive and an ancestral trait, denoting the central position evidently occupied by this new form in the phylogeny of the oriental forms leading up to *Rhinoceros*. In *Dicerorhinus sumatrensis* the anterior border of the orbit is above the second molar, a shift to the posterior portion of the skull which becomes quite characteristic of the *Diceros-Coelodonta* line. In *Rhinoceros sondaicus* and *Rhinoceros unicornis*, on the other hand, the anterior border of the orbit is above the fourth premolar, and is consequently advanced towards the front of the skull. The accompanying table will demonstrate the ratios of preorbital to postorbital lengths in the rhinoceroses mentioned above.

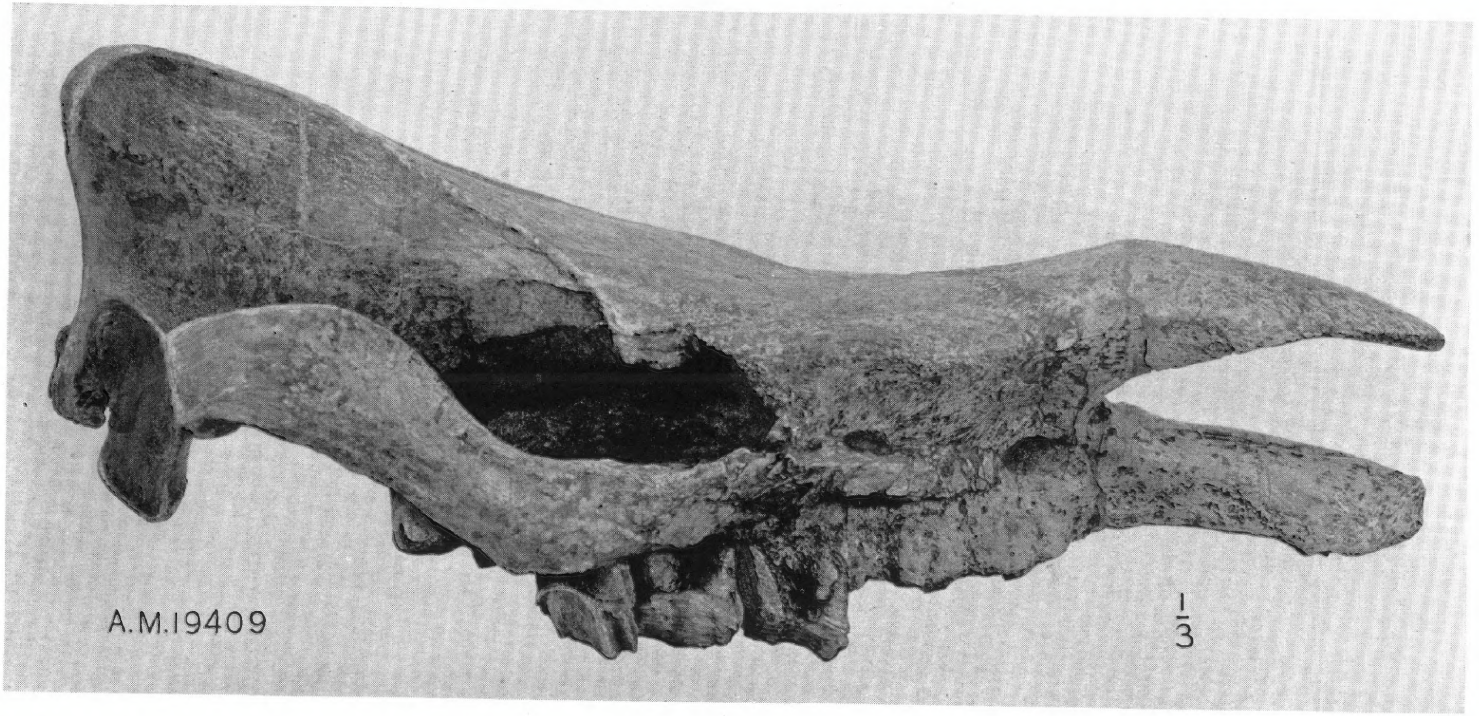

Fig. 1. *Gaindatherium browni*, new genus and species. Type, Amer. Mus. No. 19409. Skull, lateral view. One-third natural size.

TABLE, PREORBITAL—POSTORBITAL RATIOS

	Preorbital length	Postorbital length	Ratio $\frac{\text{Preorb.}}{\text{Postorb.}} \times 100$
Gaindatherium browni			
Amer. Mus. No. 19409	260 mm.	290 mm.	90
Dicerorhinus sumatrensis			
(Osborn, H.F. 1898, fig. 14)	230	287	80
Rhinoceros sondaicus			
(Osborn, H. F. 1898, fig. 14)	285	385	74
Rhinoceros unicornis			
Amer. Mus. Mam. No. 54455	265	390	68

The skull appears to be rather low, an illusion probably strengthened because of a certain amount of crushing that it has undergone. The narial notch extends back to a point above the first premolar, and it is bounded below by the maxilla and the premaxilla, which latter reaches as far anteriorly as do the nasals. The premaxillaries are very slender and long. The zygomatic arch curves gracefully upward, from front to back, and it is comparatively slender.

The occiput is rather vertical, which would be expected in a primitive form comparable with *Caenopus* or *Dicerorhinus*. In the more specialized rhinoceroses the occiput becomes either forwardly inclined, as in *Rhinoceros unicornis*, or it overhangs the condyles as in *Ceratotherium simum*. Two parietal ridges run back from above the orbits, coming almost together just in front of the lambdoidal crest, thus forming a low, incipient sagittal crest. This again is an indication of the relatively primitive structure of *Gaindatherium*, for in the more specialized rhinoceroses, in which the brain case has become expanded, the parietal crests are separated from each other.

Looking at the ventral surface of the skull we see that the anterior palatine foramina (incisor foramina) are confluent, and they form a large opening, though relatively smaller than is the case in *Rhinoceros unicornis*. The posterior nares are very wide and they extend forward to a point opposite the anterior border of the second molar, a resemblance to the Indian rhinoceros. The pterygoids and the vomer are heavy.

Owing to the fact that the basicranium is mutilated, a detailed description of it can not be given.

As in other genera belonging to the Rhinocerotidae, the postglenoid process is very long, and it is situated medially, that is, towards the midline of the skull and somewhat internal to the glenoids, thus affording a strong mandibular articulation capable of free movement. The

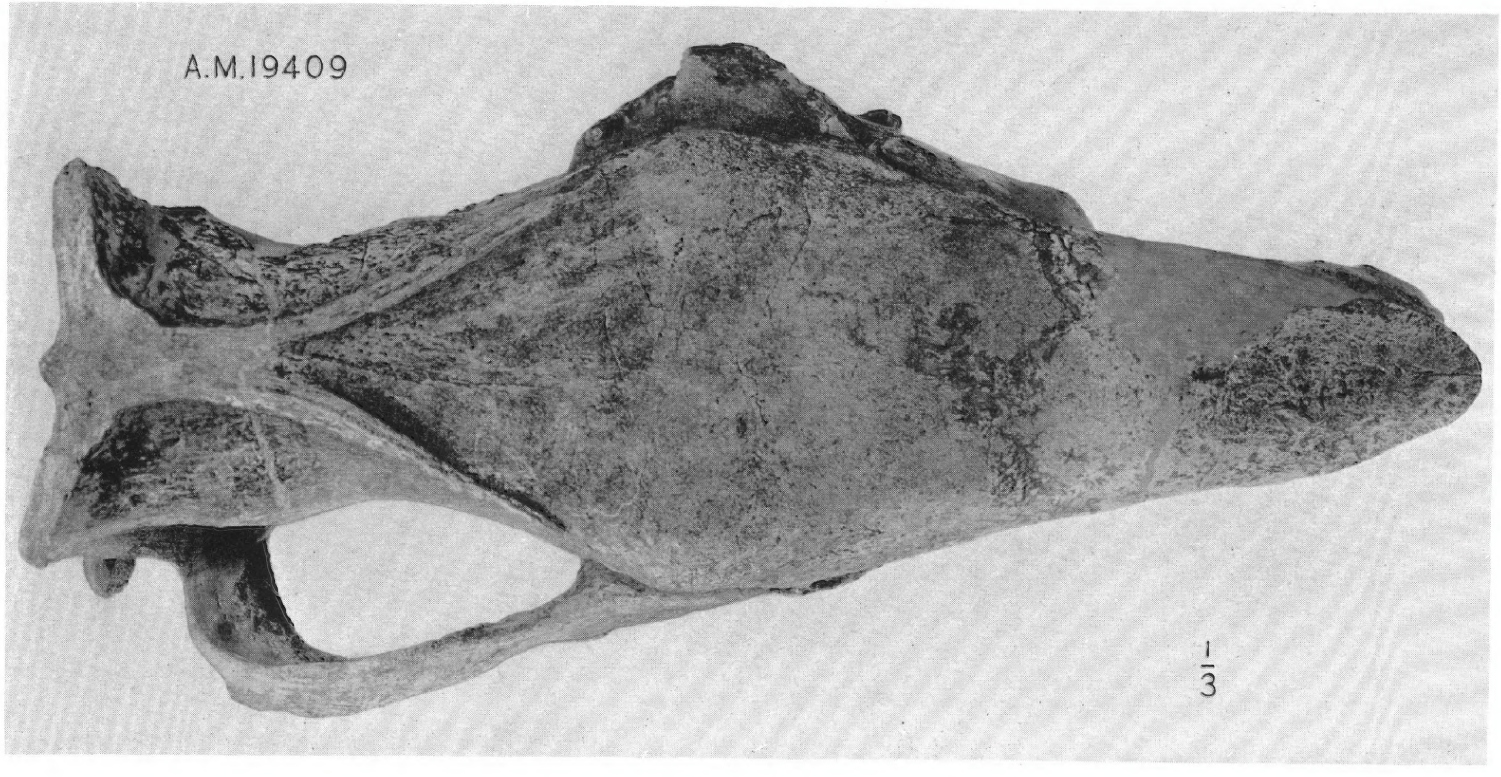

Fig. 2.—*Gaindatherium browni*, new genus and species. Type, Amer. Mus. No. 19409. Skull, dorsal view. One-third natural size.

postglenoid is joined with the post-tympanic, forming an enclosed tube for the external auditory meatus. In this last feature, *Gaindatherium* is similar to *Rhinoceros*, and is more advanced than *Dicerorhinus*.

The fusion of the post-tympanic and the postglenoid occurs independently in various lines of rhinocerotid evolution, and must therefore be regarded as an habitus character indicating narrow but not broad phylogenetic relationships. The fusion of the postglenoid and the post-tympanic is seemingly indicative of relationships within a subfamily, but it would not seem to be of sufficient constancy to warrant the establishment of ties *between* subfamilies.

This coalescence of the postglenoid and the post-tympanic may probably be due in some part to the development and the action of certain muscles, such as the digastricus, rectus capitis lateralis, obliquus capitis superior and the longissimus capitis, that attach to the par-occipital process and the mastoid region. Just what the underlying causes of the differences existing in this region of the rhinoceros skull may be, is as yet an open question. That this fusion is probably a result of function rather than of size may be implied from the fact that certain very large rhinoceroses have the external auditory meatus open below, while in other smaller forms, like the one under consideration, the fusion of the two elements is complete. Of course, the fusion of the post-glenoid and the post-tympanic may be due in part to inherent hereditary tendencies, that find different expressions in the several phylogenetic lines among the Rhinocerotidae. The answer to this perplexing question may be found in a future detailed study of the basicranium among the fossil and recent rhinoceroses.

The Dentition

Unfortunately, only the molars are present in the type specimen. The alveoli of the other teeth are well preserved, and they offer some clue as to the remainder of the dentition.

An interesting feature in this species is the fact that two incisor teeth were present, evidently I^1 and I^2. The first incisor is a laniary tooth, as is common among the Rhinocerotidae. The second incisor is seemingly small, and evidently on the verge of disappearing.

The molar teeth, as shown in the type skull, are brachyodont and rather simple, being characterized by the complete absence of an ante-crochet or a crista, while the crochet is present in the last molar but is not strongly developed. The parastyle is prominent. There are anterior and posterior cingula, but none internally.

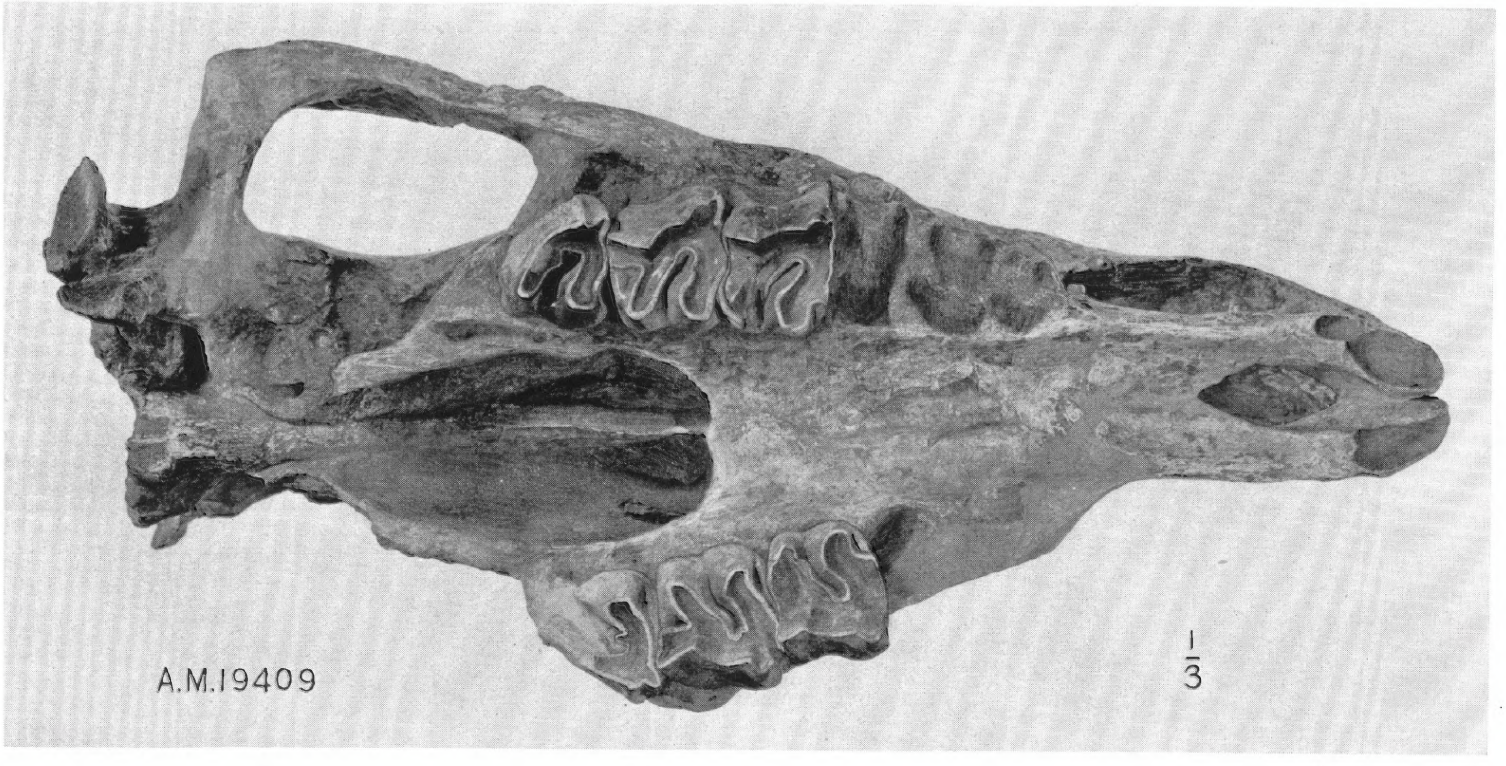

Fig. 3.—*Gaindatherium browni*, new genus and species. Type, Amer. Mus. No. 19409. Skull, ventral view. One-third natural size.

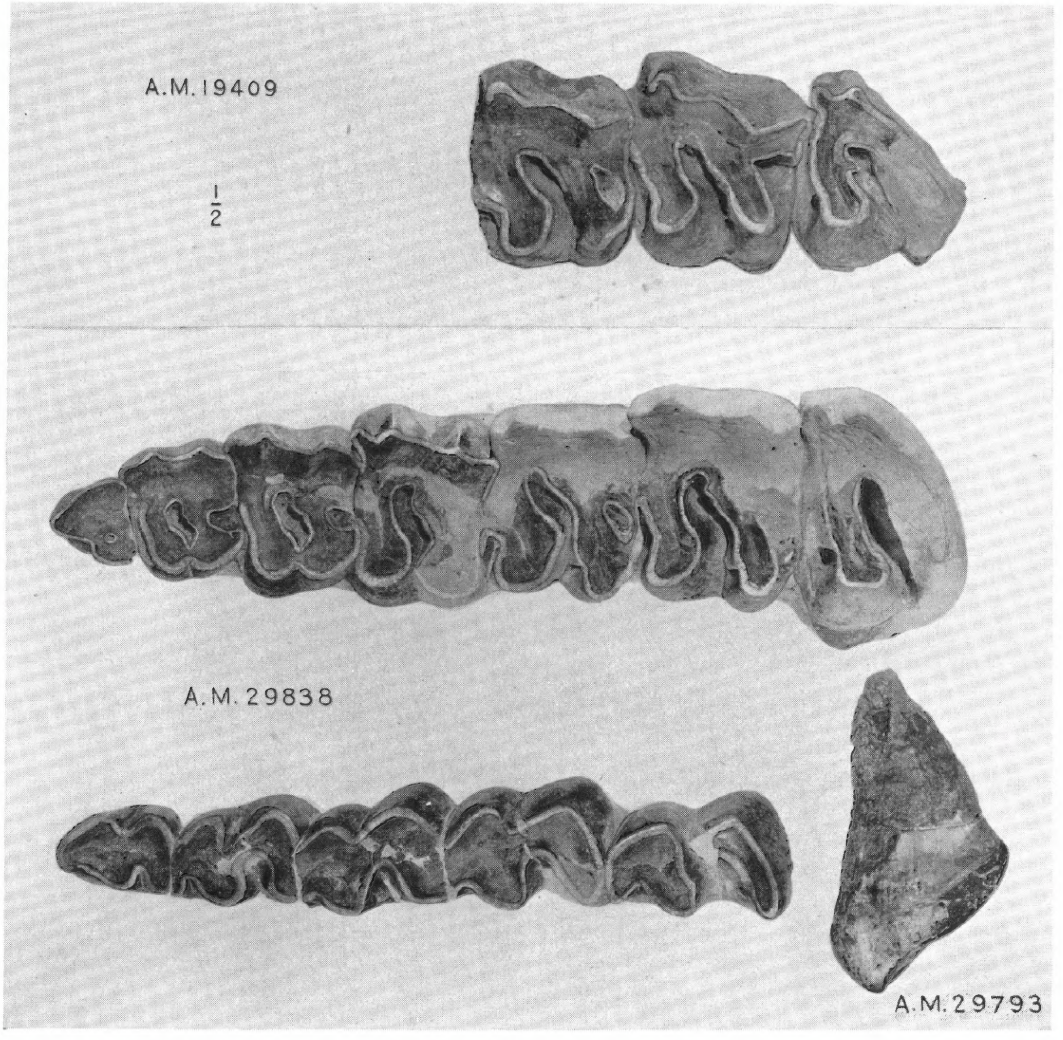

Fig. 4.—*Gaindatherium browni*, new genus and species. Upper and lower dentitions. At top: Type, Amer. Mus. No. 19409, left M^{1-3}, crown view. In middle: Amer. Mus. No. 29838, left P^1-M^3, crown view. At bottom: Amer. Mus. No. 29838, right P_2-M_2, crown view, and Amer. Mus. No. 29793, upper incisor, lateral view. All figures one-half natural size.

Another specimen, Amer. Mus. No. 29838, shows the characters of the premolars and of the lower grinding dentition. The premolars are, with the exception of the first one, essentially molariform in pattern. The first premolar is small and triangular. It might be well to say that the molars and premolars in this species are rather broad transversely, as compared with their anteroposterior length.

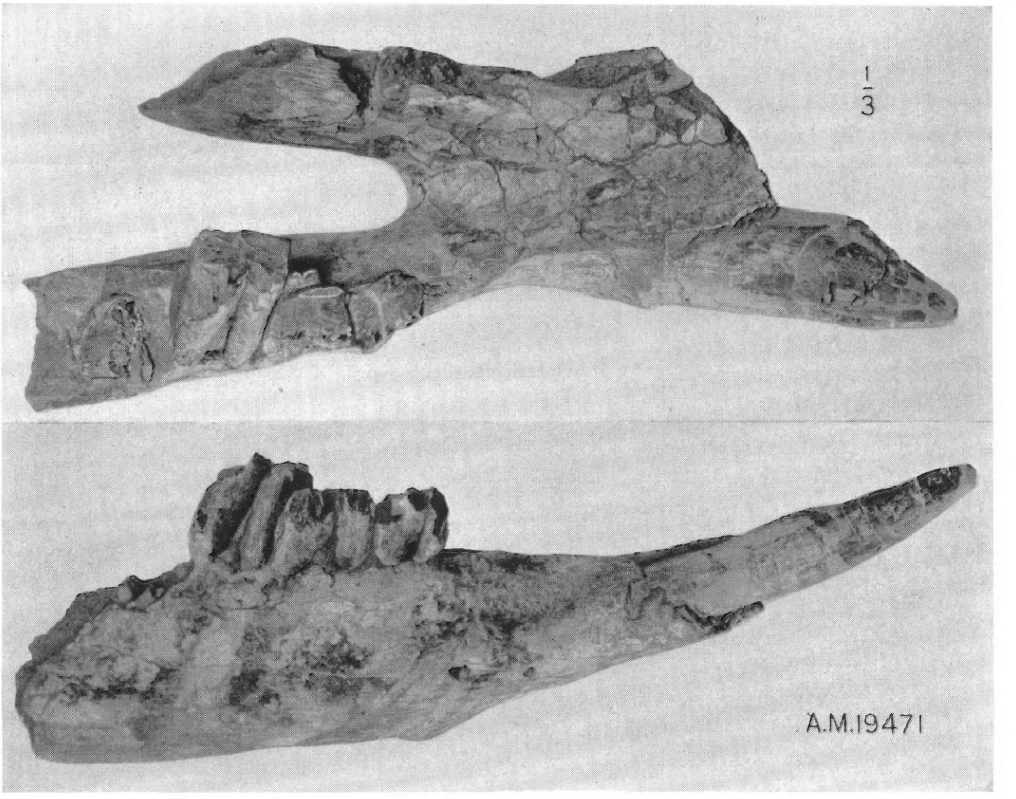

Fig. 5.—*Gaindatherium browni*, new genus and species. Amer. Mus. No. 19471, symphysis of mandible. Superior view above, lateral view below. One-third natural size.

Coming now to the lower dentition, we see that it follows the usual rhinocerotid form. The first premolar is absent; the second one is small and narrow. The succeeding premolars and the molars consist of the usual anterior and posterior crescents.

A mandibular symphysis, Amer. Mus. No. 19471, from the lower portion of the Middle Siwalik beds is here referred to *Gaindatherium*. The specimen is crushed, and the three cheek teeth present are badly

broken, making its identification somewhat problematical. This specimen is assigned to *Gaindatherium*, rather than to *Chilotherium* (the genus most abundantly found in these deposits), because of the general shape of the symphysis, which is rather narrow and shallow, and somewhat constricted anterior to the cheek teeth. Its general form is similar to the form of the mandibular symphysis in *Rhinoceros*. In *Chilotherium* the symphysis is very broad, deep and heavy. Moreover, the premolar-incisor diastema is of a length proper for *Gaindatherium*. Then again, the wear surface on the incisor is similar to that in the modern *Rhinoceros*, that is, it is comparatively short. In *Chilotherium* this surface is long. Furthermore, the general shape of the incisor in this supposed *Gaindatherium* jaw is more like that of the incisor of *Rhinoceros* than it is like the incisor of *Chilotherium*.

The various structural characters of the dentition of *Gaindatherium*, discussed above, are illustrated by the accompanying figures.

Measurements

Gaindatherium browni, new genus and species

Amer. Mus. No. 19409, type

Skull

Length, lambdoidal crest to tip of nasals	496 mm.
Length, condyles to incisor alveolus (estimated)	520
Length, anterior border of orbit to incisor alveolus	243
Length, anterior border of orbit to condyles	290
Width at glenoids	298
Width of parietals, narrowest portion	93
Width of frontals, supraorbital	168
Width of palate at M^1	68
M^1 length	40
width	51
M^2 length	42
width	52
M^3 length	37
width	48

Amer. Mus. No. 29838, paratype

	length	width
P^1	19 mm.	22.5 mm.
P^2	28	34.5
P^3	32	43
P^4	37	49
P_2	28.5	21.5
P_3	30	26
P_4	36	28
M_1	40	30
M_2	43	28

Gaindatherium browni, Amer. Mus. No. 19471, mandibular symphysis.

Depth of symphysis at P_2	66 mm.
Width of symphysis at narrowest part	79
Length of symphysis	135
Transverse diameter of incisor	39
Vertical diameter of incisor	27

DISCUSSION

If the skull of *Gaindatherium browni* is considered in its entirety, and all of its anatomical characters are evaluated, we see that it is seemingly more closely related to the modern *Rhinoceros* than to any other genera of the Rhinocerotidae. Of course, *Gaindatherium*, being a relatively primitive rhinocerotid, shows certain resemblances to other generalized types, such as *Caenopus* or *Dicerorhinus*. These are the heritage characters, derived from a community of origin and carried over into forms evolving along divergent lines. On the other hand, many of the characters of *Gaindatherium* are of later origin, and these are the habitus characters that would seemingly ally it with *Rhinoceros*. These characters are listed below.

A. Heritage characters in *Gaindatherium*

1. The light, slenderly built skull is an heritage character derived from an ancestor of relatively small size and slender proportions.

2. The centrally placed orbit is a character derived from a primitive ancestor. In the primitive perissodactyls the preorbital portion of the skull is approximately equal in length to the postorbital region. In advanced forms the orbit tends to lose its central position.

3. The slight sagittal crest is a primitive character, due to the fact that the brain case has not expanded to any great degree.

4. The vertical occiput is a primitive heritage character.

5. The presence of the second upper incisor is primitive.

6. The brachyodont, simple molars show the heritage characters of an ancestor similar to *Caenopus*.

B. Habitus characters in *Gaindatherium*

1. The "saddle shaped" skull is a definite advance towards *Rhinoceros*.

2. The presence of one nasal horn is an habitus character in the direction of *Rhinoceros*.

3. The union of the postglenoid and the post-tympanic is again an habitus character that is also found in *Rhinoceros*.

4. The presence of a crochet on the last molar in *Gaindatherium* is a character that would seem to point towards *Rhinoceros*. In the latter genus the crochet and crista are well developed, but the antecrochet is not distinct. In *Gaindatherium* the crochet is present on the last molar, and the antecrochet is not distinct.

5. The relatively narrow, shallow symphysis and the straight lower incisor would seem to be characters indicative of a relationship with *Rhinoceros*.

CONCLUSIONS

Gaindatherium browni is a new genus and species of the Rhinocerotidae, and it represents a form seemingly directly ancestral to the modern Indian *Rhinoceros*. It retains many primitive characters, which cause it to bear certain resemblances to *Dicerorhinus sumatrensis*, another relatively primitive member of the Rhinocerotidae. From the presence of *Gaindatherium browni* in the Lower Siwaliks, it may be assumed that the *Rhinoceros* group probably split off from the general stem of the Rhinocerotidae during Miocene times. Furthermore, it would seem that the genus *Rhinoceros* had its origin from *Gaindatherium*, in India, and that the phylogenetic development of this group was experienced in the region directly southwest of the Himalayas.

SUGGESTED PHYLOGENETIC RELATIONSHIPS OF *Gaindatherium*

	Nasal and frontal horns Postglenoid and posttympanic separate External auditory meatus open below	Nasal horn Postglenoid and posttympanic fused External auditory meatus closed below
Advanced	*Coelodonta* *Ceratotherium* *Diceros*	*Rhinoceros*
Primitive	*Dicerorhinus*	*Gaindatherium*
Ancestral	*Caenopus*	

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